Declassified in Part - Sanitized Copy Approved for Release 2012/09/06 : CIA-RDP79B00873A001900010071-6

CONFIDENTIAL

NPIC/TSG/ESD/TEB-19/70
7 July 1970

MEMORANDUM FOR THE RECORD

SUBJECT: Validation of Corning Test Data on Lenticular Rear Projection Screen (Trip Report)

1. Discussions with [redacted] took place 17-18 June 1970 at a Corning facility in Raleigh, N.C. [redacted] were given handouts of some preliminary data taken on the lenticular screen sample. [redacted] discussed possible test procedures and definitions for the parameters specified by the contract, pages 19 and 20 of Corning's Final Technical Report, P-19-30, "Improved Screen for Rear-Projection Viewers" dated January 19, 1968. No test procedures had been received by NPIC prior to our trip and no written test procedures were given to us during this visit. RED Memo NPIC/TSSG/RED-160/70 dated 25 June 1970 requests TEB recommendations as to what test procedures should be incorporated into the new contract for a 30 inch by 30 inch lenticular rear-projection screen. 25X1 25X1 25X1

2. The preliminary data covered relative luminances of the center of the screen at various viewing angles, luminances of two Polacoat screens at a headon viewing angle relative to the lenticular screen, integrated transmittances into a specially selected rectangle, and some square wave modulation readings.

3. The parameters specified in the contract are: T_d, T_{45}, T_{spec}, V, R_d, Resolution, Color Fidelity, and Size. The following description of Corning's test procedures came from my notes of the 17-18 June visit to Corning.

3.1 T_d is the diffuse transmittance of the screen. [redacted] defines this as $T_d = T_{90} - T_{spec}$ where T_{90} is the ratio of the light scattered by the screen into the forward hemisphere and the incident light (from the projector). See subparagraph 3.3 for T_{spec}. The measurement technique uses an Edmund Scientific Si solar cell Cat. #30,538 with a homemade microammeter as the detector and a tungsten filament lamp with a set of filters (which were not yet finalized) as the illuminant. The spectral response of the detector is to be reported. An f/10 projection lenses is used to focus the filament on 25X1

CONFIDENTIAL

GROUP 1
Excluded from automatic downgrading and declassification

Declassified in Part - Sanitized Copy Approved for Release 2012/09/06 : CIA-RDP79B00873A001900010071-6

Declassified in Part - Sanitized Copy Approved for Release 2012/09/06 : CIA-RDP79B00873A001900010071-6

SUBJECT: Validation of Corning Test Data on Lenticular Rear Projection Screen (Trip Report)

the screen to be measured. The light collection optics for the detector has a numerical aperture (N.A.) large enough to collect the bulk of the light diffused by the lenticular screen. [redacted] said that he feels 25X1
that the light falling outside a 34° half angle cone will be only one or two percent. He also indicated that any good rear-projection screen will have a negligibly small T_{spec}. Ambient light is essentially reduced to zero for his measurements.

3.2 T_{45} is the efficiency of the screen determined by collecting the light within a 45° half angle cone with and without the screen in place. See subparagraph 3.1 for equipment and procedures. [redacted] 25X1
said that the data to be reported for the current contract will include T_{30} and T_r as bonuses. T_r is a rectangular (24° high by 27° wide) instead of conical collection of light from the screen. HALF 4's

3.3 T_{spec} is the specular transmission. Specular means that no scattering or refraction has taken place. [redacted] indicated that any 25X1
good rear-projection screen will have a negligibly small percentage of undeviated or non-scattered (specular) light. The test procedure, therefore, is designed merely to verify that T_{spec} is inappreciable. The spectral response of the photomultiplier detector is to be reported. The narrowband interference filter and other filters to be used with the illuminant were not yet selected. Collimated light will be used. Absence of a spike at a zero degree viewing angle is the desired result.

3.4 V is the brightness variation where the variable is viewing angle rather than position on the screen. A collimated Xe arc lamp with a Corning 3-71 filter is used as the illuminant. The detector is an S-20 photomultiplier with a N.A. simulating the eye at ten inches. The spectral response of the detector is to be reported. The screen area illuminated with collimated light will be greater than 1 mm in diameter and the field of view of the detector will be less than or equal to 1 mm in diameter.

3.5 R_d is the diffuse reflectance. [redacted] will use a Beckman 25X1
DK-2 Spectroreflectometer with its integrating (light collecting) sphere. It will measure total reflectance for the lenticular screen, R_t. This is because the lenticular front surface of the lenticular screen does not allow the specular reflectance, R_{spec}, to be easily eliminated. A MgO standard will be used with a substitution technique. The N.A. of the Beckman monochromator is equivalent to about f/11.

Declassified in Part - Sanitized Copy Approved for Release 2012/09/06 : CIA-RDP79B00873A001900010071-6

Declassified in Part - Sanitized Copy Approved for Release 2012/09/06 : CIA-RDP79B00873A001900010071-6

SUBJECT: Validation of Corning Test Data on Lenticular Rear Projection Screen (Trip Report)

3.6 Resolution is defined as square wave modulation [redacted] 25X1
The detector is an EG&G Radiometer believed to contain an S-10 photosurface. The illumination is planned to be at 533 nanometers and a second, yet to be chosen, illuminant. A square wave bar target is to be projected onto the screen with the bars at specified angles to the lenticules of the lenticular screen. [redacted] indicated that they may 25X1
report contact resolution (The bar target is placed in contact with the screen and illuminated with the projector in the open gate state.) data. The detector is moved over about five line pairs to average the amplitude readings. This can be done with and without a rear-projection screen in place. In the contact resolution case, the screen can be placed before or behind the square wave target. The detector slit is adjusted to accept one fifth or less of a half cycle at the highest spatial frequency to be measured (through a magnifier). A Diffraction Limited, Inc. target is used. Subjective measurements with USAF Three-Bar targets and its improvement with the screen in sideward motion will be a bonus if reported.

3.7 Color Fidelity - [redacted] decided to use $B_{Red}(\theta)$ and $B_{Blue}(\theta)$ 25X1
as his notation. He plans to measure both as a function of viewing angle to the center of the screen. A collimated Xe arc, red and blue filters, and an S-20 photomultiplier tube (see Subparagraph 3.4) will be used. Color fidelity will be the match between the $B_{Red}(\theta)$ and $B_{Blue}(\theta)$ spectral curves. In addition he may measure $T_{90}(\lambda)$ over the range λ = 700 nm to λ = 350 nm using the procedure in subparagraph 3.1 with a Beckman radiometer.

3.8 Size is the physical height and width of the rear-projection screen. My opinion is that Corning intended to report as the size of the screen, the size of the sample fabricated rather than the size of the area over which most of the other data would be taken. No uniformity measurements over the face of the lenticular screen are planned per [redacted] The measurements will be made at the center of the screen 25X1
only.

3.9 The data-taking procedures used by Corning do not use formal statistical treatment. [redacted] indicated that a test instrument may 25X1
be tried about five times to get an idea of the error of the instrument. Then one measurement is made of the test item. When the data does not appear right, more measurements are made.

4. TEB's commentary, conclusions, and recommendations will deal with the adequacy of the definitions of the variables to be tested, the

Declassified in Part - Sanitized Copy Approved for Release 2012/09/06 : CIA-RDP79B00873A001900010071-6

Declassified in Part - Sanitized Copy Approved for Release 2012/09/06 : CIA-RDP79B00873A001900010071-6

SUBJECT: Validation of Corning Test Data on Lenticular Rear Projection Screen (Trip Report)

validity of the test procedures to measure those variables, and the usefulness of such test data to the purposes of NPIC.

4.1 Diffuse Transmittance (T_d)

a. The definition seems adequate.

b. The test procedure seems adequate for a lenticular screen when T_{Spec} is negligible, when the light not collected by the detector is known to be small, and when the test procedure takes into account the changes, when a screen is inserted, in correlated color temperature and incident angle of the light. The test procedure would not be adequate to get comparative data from a nearly Lambertian screen or from screens having very broad viewing angles.

c. TEB does not believe that T_d is a worthwhile parameter to measure for the purpose of evaluating a rear-projection screen for use in photointerpretation equipment. The reason is that a large T_d might mean only that a large amount of incident light is missing the audience volume and that a small T_d might mean only that there is absorption designed into the screen to reduce ambient light problems.

4.2 Efficiency of the Screen (T_{45})

a. The definition seems adequate.

b. The test procedure seems adequate.

c. When the audience volumes are known, it would be better to tailor this variable to fit them. When the audience volumes are not known, a selected range of efficiency variables might be in order. T_{45}, which represents a 45° half angle cone, is not the best efficiency variable for usual audience volumes which are not circular and are wider than they are high. The present 6" x 6" lenticular screen essentially cuts off at 27° and 24°. If the desired audience volume matches these cutoffs, a T_{45} efficiency measurement could make the lenticular screen look bad (unnecessarily) with respect to other screens. HALF ANGLES

Declassified in Part - Sanitized Copy Approved for Release 2012/09/06 : CIA-RDP79B00873A001900010071-6

Declassified in Part - Sanitized Copy Approved for Release 2012/09/06 : CIA-RDP79B00873A001900010071-6

SUBJECT: Validation of Corning Test Data on Lenticular Rear Projection Screen (Trip Report)

4.3 Specular Transmission (T_{Spec})

a. The definition seems adequate.

b. The test procedure seems adequate.

c. This is a variable that should be checked at non-zero viewing angles also.

4.4 Brightness Variation (V)

a. The definition is not complete. $V(\theta)$, where θ is the viewing angle would be better. Still better would be $V(\theta, \alpha)$ where α is the angle the θ plane makes with a horizontal line on the screen.

b. The test procedure is adequate if the area of the screen illuminated is sufficiently larger than 1 mm in diameter to accommodate the maximum viewing angle to be measured.

c. Additional measurements should be made with the incident collimated light at suitable non-perpendicular angles.

4.5 Diffuse Reflectance (R_d)

a. The definition is adequate.

b. The test procedure is inadequate. The current 6" by 6" lenticular screen has a ribbed front surface. This causes the specularly reflected light to be spread out inside the integrating (light collecting) sphere and to be measured with the diffusely reflected light. Since an adequate test procedure would be difficult to devise for this case, a different parameter definition might be in order.

c. If the resources for it are available the best parameter to measure would be $R(\theta, \alpha, \theta', \alpha')$ where the primes indicate the angles of the incident light.

Declassified in Part - Sanitized Copy Approved for Release 2012/09/06 : CIA-RDP79B00873A001900010071-6

Declassified in Part - Sanitized Copy Approved for Release 2012/09/06 : CIA-RDP79B00873A001900010071-6

SUBJECT: Validation of Corning Test Data on Lenticular Rear Projection Screen (Trip Report)

4.6 Resolution

a. The definition is adequate.

b. The test procedure seems adequate.

c. RED intends to have Boeing establish an objective measure which correlates with PI performance in extracting information from imagery. It will be at least a year before any results can be expected. Resolution defined as square wave modulation is not to be confused with MTF (modulation transfer function). Corning's original intent of dividing out the MTF of the magnifier or the projector using square wave modulation measurements would not be valid. Since no other measure is known which is better, subjective readings with USAF Three Bar targets and objective square wave modulation measurements seem to be reasonable things to do.

4.7 Color Fidelity

a. No definition was given as such.

b. The proposed procedures may give some information on color fidelity but it might be incorrect information when used for ranking screens. For our purposes the procedures cannot be called incorrect.

c. TEB does not know whether this or any other objective non-photographic test would detect the colored diffraction pattern that is quite visible in the current 6" by 6" lenticular screen sample.

4.8 Size

a. The definition is inadequate. Under this definition, ~~with~~ no uniformity requirements, the size could be increased indefinitely with no change in the other parameters.

b. No test procedures as such were proposed.

c. TEB recommends that each of the foregoing parameters be measured at a suitable number of points over the screen. The size of the screen should be related either to the area over which the measurements are made or to the area over which suitable results are achieved.

25X1

Declassified in Part - Sanitized Copy Approved for Release 2012/09/06 : CIA-RDP79B00873A001900010071-6

Declassified in Part - Sanitized Copy Approved for Release 2012/09/06 : CIA-RDP79B00873A001900010071-6

CONFIDENTIAL

SUBJECT: Validation of Corning Test Data on Lenticular Rear Projection Screen (Trip Report)

Distribution:
Orig. - Project File
1 - TSG/RED
1 - OCH/ESD
1 - TSG/ESD/TEB

CONFIDENTIAL

Declassified in Part - Sanitized Copy Approved for Release 2012/09/06 : CIA-RDP79B00873A001900010071-6